

## CLAIMS

1. A fuel fractionation method for an internal combustion engine comprising the steps of:

applying an operation for promoting a fractionation of a fuel of the internal combustion engine to a fractionation passage while making the fuel flow to the fractionation passage, thereby fractionating the fuel into a gas phase fuel and a liquid phase fuel within the fractionation passage;

conducting the fractionated gas phase fuel and the fractionated liquid phase fuel to a branch point of the fractionation passage; and

separating the gas phase fuel and the liquid phase fuel to an upper branch passage and a lower branch passage, respectively due to gravity.

2. A fuel fractionation apparatus for an internal combustion engine comprising:

a fractionation passage which is connected to a fuel supply system of the internal combustion engine and reaches a branch point of a terminal end through a fractionation section to which a fractionation promoting effect of a fuel is applied;

a liquid phase branch passage which is branched to a lower side from the branch point; and

a gas phase branch passage which is branched to an upper side than the liquid phase branch passage from the branch point.

3. The fuel fractionation apparatus according to claim 2, wherein an inlet of the liquid phase branch passage is provided with a gas phase fuel inflow inhibiting portion for inhibiting the gas phase fuel from flowing into a downstream side of the liquid phase branch passage due to an existence of the liquid phase fuel.

4. The fuel fractionation apparatus according to claim 3, wherein an orifice is provided in the gas phase fuel inflow inhibiting portion.

5. The fuel fractionation apparatus according to any one of claims 2 to 4, wherein the fractionation section extends through an area to which a heating operation is applied due to a heat wasted from the internal combustion engine as the fractionation promoting operation.

6. The fuel fractionation apparatus according to claim 5, wherein an exhaust heat of the internal combustion engine is utilized as the heat wasted from the internal combustion engine.

7. The fuel fractionation apparatus according to any one of claims 2 to 5, comprising a pressure regulating device for regulating a pressure within the fractionation passage as a device for generating the fractionation promoting operation.

8. The fuel fractionation apparatus according to claim 7, comprising a pressure control device for controlling an operation of the pressure regulating device based on a temperature of the fuel flowing through the fractionation passage.

9. The fuel fractionation apparatus according to claim 5 or 6, comprising:

a temperature detecting device for detecting a temperature of the branch point;

a temperature adjusting device capable of adjusting the temperature of the branch point; and

a temperature control device for controlling an operation of the temperature adjusting device based on the temperature detected by the temperature detecting device such that the temperature of the branch point is maintained at a predetermined target temperature.

10. The fuel fractionation apparatus according to claim 9, wherein the temperature adjusting device changes a flow rate of the fuel conducted to the fractionation section so as to adjust the temperature of the branch point.

11. The fuel fractionation apparatus according to claim 10, wherein the temperature control device operates the temperature adjusting device such that the flow rate of the fuel conducted to the fractionation section is limited to a minimum value when

the temperature detected by the temperature detecting device deflects from an allowable range with respect to the target temperature.

12. The fuel fractionation apparatus according to claim 10 or 11, comprising:

a distillation fuel container for accumulating the fuel conducted from the gas phase branch passage; and

an accumulation volume detecting device for detecting an accumulation volume of the distillation fuel container,

wherein the temperature control device lowers the target temperature with the accumulation volume detected by the accumulation volume detecting device increasing.

13. The fuel fractionation apparatus according to any one of claims 5 to 12, wherein the fractionation section is provided within the exhaust passage of the internal combustion engine, and the branch point is provided in an outer side of the exhaust passage.

14. The fuel fractionation apparatus according to any one of claims 5 to 13, wherein an exhaust gas purifying device is provided in the exhaust passage of the internal combustion engine, and the fractionation section is provided so as to carry out heat exchange between the fractionation section and the exhaust passage in a downstream side of the exhaust gas purifying device.

15. The fuel fractionation apparatus according to claim 7 or 8, wherein the fractionation section is provided so as to carry out heat exchange between the fractionation section and an engine main body surrounding a combustion chamber in the internal combustion engine or a cooling water of the engine main body.